Ontology of the Mirror World*

Jan Koenderink

University of Leuven (KU Leuven) & Utrecht University

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Introduction

The "mirror world" (*Spiegelwelt* or *Gegenwelt*) was introduced by Jakob von Uexküll (1920; Bernhard Hassenstein 2001). It marks a metabletic (Bertha Mook 2009; Jan Hendrik van den Berg 1956) turn in the life sciences of the first quarter of the 20thc., contemporary with major paradigm shifts in physics (e.g., Albert Einstein 1905; Niels Bohr 1905-1911; Erwin Schrödinger 1926; …), philosophy (e.g., Edmund Husserl 1913; Alexius Meinong 1899; Brett Buchanan 2008; …), psychology (e.g., Carl Stumpf 1918; Max Wertheimer 1922-3; Wolfgang Köhler 1929; …), and the arts (for instance, Rainer Maria Rilke (1902) in poetry and Franz Marc (1880–1916) in painting). Augmented with somewhat later ideas concerning the genesis of awareness (Schrödinger 1958; Jason Walter Brown 1991; …) and methods of probing (Whitman Richards 1982; Jan Koenderink 2011a; …) one obtains a rough, but coherent account of the psychogenesis of visual awareness.

I start by introducing the concept of mirror world (*Spiegelwelt*) and so forth, then discuss their role in an ontology of the objects of visual awareness, the *Gestalts*.

Foundations

Jakob Von Uexküll's Ethology

Jakob von Uexküll (1864–1944) is the father of ethology, which was "officially" launched with the 1973 Nobel Prize in Medicine awarded jointly to Karl von Frisch, Konrad Lorenz and Nikolaas Tinbergen. I give a summary account of some of his main ideas here.

Animals strike us because of their autonomic behavior. They apparently act by monitoring and acting on their environment (*Umgebung*). The repertoire of actions is limited to an action world (*Wirkwelt*) and the repertoire of the monitoring is limited to a sensed world (*Merkwelt*).

Human *Wirkwelt* is largely limited to the displacement of masses, deformation of solids, secretion of hormones, and so forth. Alien creatures eject ink clouds (*cuttlefish*), create electric shocks (*electric eel*), change color (*chameleon*), emit ultrasound (*bats*), spin webs (*spider*) and so forth, thus have a very different *Wirkwelt*.

Human *Merkwelt* includes rudimentary chemical and mechanical senses, air vibrations and electromagnetic radiation in limited parameter regions. Alien creatures detect electric

fields (*sharks*), hear ultrasonic sounds (*bats*), see polarization states of the electromagnetic field (*honeybee*), use infrared thermal imaging (*rattlesnake*), and so forth, thus have a very different *Merkwelt*.

The union of *Merkwelt* and *Wirkwelt* makes up the *Umwelt* of an animal, necessarily correlated with a small corner of "the" *Umgebung*. Animals living in the same environment have different *Umwelts*. To the extents that their *Umwelts* are distinct, they are necessarily mutually *alien* (Thomas Nagel 1974). A lantern pole is a different object to me walking by it, my dog sniffing it, a dove sitting upon it, or a moth flying around its lantern. We do different things with it: "*What I do is me, for that I came"* (Gerard Manley Hopkins 1918).

All animals are complete and perfect as they are. A mole is not blind and humans don't lack wings. *Umwelts* may be very different, yet animals interact by way of the *Umgebung*. The *Umgebung* is common to all, although nobody can *experience* it as such. Interaction is not to be confused with "communication".

The spider and the fly have different *Umwelts* that are evidently "in tune" in the sense that the spider's web is mechanically and geometrically fit to fool flies – they can't see the threads – and catch them – right mesh size, sufficient mechanical strength, ... Yet spider babies spinning their first web are neither handed a "fly-manual", nor learn from experience.

Such correspondences are the rule, all animals live in symbiosis with countless others. We depend for our lives on our cells, the mitochondria in these cells, on numerous bacteria in our guts, on chickens, on pigs and apple trees and these in turn depend on us. Von Uexküll's simile of each organism contributing its solo voice to a huge orchestra is both charming and apt. Unfortunately, such ideas stamped him a "vitalist" – unmentionable in late 1930's biology – and effectively led to the end of his career, leaving his ideas to be harvested by colleagues who where smart enough to jump the Darwinean bandwagon. This controversy tragically divided biology in the early 20th c. (Geert Jan de Klerk 1979). Von Uexküll's proto-cybernetic reasonings were only partly understood by either side.

Simplest animals are understood via a *loop* (*Funktionskreis*) that runs through the animal's body and its environment. The body is part of the environment, the loop an abstract, formal object having neither beginning nor end (figure 1). I start my description arbitrarily at the sensor (*Merkorgan*). When some interaction at the sensitive body surface stimulates the sensor, it sends a message to the effector (*Wirkorgan*). The effector changes the environment, leading to a change in stimulation of the sensor, thereby closing the loop.

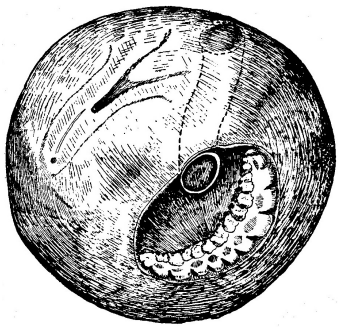

Fig. 1 A "magical" tunnel dug by the pea weevil larva. Why "magical"? Why, the larva has no use for the tunnel. It will never use it. It plays no functional role in its life. We understand its function if we grant that the larva

and the beetle "sing a duet" together – in von Uexküll's terms – although they don't even know each other. In the pea weevil universe the larva and beetle do not exist in some temporal order, nor simultaneously. It is typical for loops that they have beginning nor end, like the proverbial chicken and egg loop.

The physical event leading to stimulation of the sensor evokes a message that is fully unlike it. The message may be an electrochemical, neural event, whereas the stimulation might be mechanical, chemical, photic, acoustic, thermal, or whatever. "Messaging" simply means any process that stimulates the effector. The effect is fully unlike the message, a muscle twitch, glandular secretion, and so forth. "Messaging" is not "communication"! The effector knows nothing of the sensor, or vice versa, they share no language. The loop closes through the environment. Here the "messaging" between effector and sensor is physical causation.

Such simple systems allow surprisingly complicated behavior (Valentino Braitenberg 1984). They can be almost arbitrarily *specific* given the properties of the sensor and effector. Only certain properties of the environment can affect behavior, these are the "cues" (*Merkmale*). Objects involved in the interaction are "cue bearers" (*Merkmalsträger* or *Gegengefüge*). Von Uexküll's examples are striking and have been quoted frequently in the philosophical literature (Jui-Pi Chien 2006).

Von Uexküll was able to perform such analyses because he studied simple marine creatures, for which he had "God's Eye" (Koenderink 2014a). He positioned himself more advantageously than Sigmund Freud (1900) could. Humans cannot really study the human *Funktionskreise*, because humans *are what we are*. Freud tried, but – of course – he lacked the God's Eye view for humans, as we all do.

With the "new loop" (*neuer Kreis*) von Uexküll (1920) introduces a loop controller between the sensor and the effector that simulates the causal structure of the environment (figure 2). The effector receives its messages from the controller, rather than from the sensor. The sensor also sends direct messages to the controller, a kind of "first warning", protopathic alerts. More importantly, the controller maintains two-way messaging with the sensor in which the sensor plays a passive, the controller an active role. The controller "pokes" the sensorium and thus "feels for friction". This implements a "counter world" (*Gegenwelt*) or "mirror world" (*Spiegelwelt*).

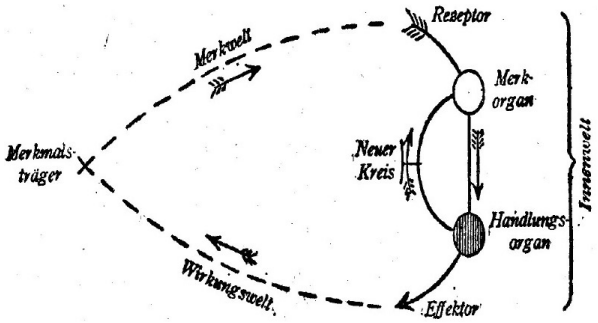

Fig. 2 Von Uexküll's *Neuer Kreis* short-circuits the part of the loop through the environment. This part has been dashed, only the *Innenwelt* being fully drawn. The "world" has been reduced to a "cue bearer" (*Merkmalsträger*). Von Uexküll did not bother to draw it. It plays no role except as a link in the whole chain.

This is the basis for the intentional "inner world" (*Innenwelt*), which is the animal's reality (*Wirklichkeit*), whereas the *Gegengefüge* is the Kantian *Ding an sich* (Immanuel Kant 1781), the God's Eye view (Koenderink 2014a, *Realität*). The *Innenwelt* is an object of experimental phenomenology, rather than science. It is the world from the animal's perspective. This notion led to Rilke's poem *Der Panther* (1902) and Marc's remarkable paintings and drawings (early 20thc.). Rilke strifes for "in-seeing" (*Einsehen*), experiencing the animal from its inside so to speak ("*… letting oneself into the dog, exactly into its center, to the place where it starts being a dog …*"). Von Uexküll describes it in his *Streifzüge* (1934). It made a huge impact on "continental philosophy" (Chien 2006).

The functionality of the new loop implies the *Reafferenzprinzip* usually attributed to Erich von Holst and Horst Mittelstaedt (1950) who published it two decades after von Uexküll did, without reference – perhaps they were scared of being stamped vitalists themselves. It has become a basic principle in sensorimotor physiology and a foundation of James Gibson's (1950) "direct perception" in psychology. Since loops have neither beginning nor end, perception is "direct" that is literally *timeless* once you're in an active sensorimotor loop.

Elements in the loops are not to be identified with physical or physiological objects. Nor need they be simple. The *Merkorgan* and *Wirkorgan* could be a single physiological organ regarded from different perspectives. For instance, an army is an organism in which "the soldiers" (single object!) is both a *Merkorgan* and a *Wirkorgan*, assembled of numerous men. The army has a strict hierarchy with the general at top, in which message passing *between* levels is highly asymmetric – there is no "communication". "Meanings" and "qualities" differ on all levels. Yet the functioning of the "the army" can be aptly described in terms of von Uexküll's functional cycle, including the *neuer Kreis*.

In more complicated cases one speaks of the *Situationskreis* (Thure von Uexküll 1986). Here the controller is influenced by the emotional core, situational awareness, drives, and so forth. These set its mode of operation, for instance, the questions it poses in probing the sensorium, or the default actions triggered by protopathic alerts. The mirror world is necessarily experienced in some *mood* (Martin Heidegger 1927). Von Uexküll (1934) illustrates this with wonderful observations of the behavior of the hermit crab in various *Stimmungen*.

Erwin Schrödinger's Sparks of Awareness

From a psychologist's perspective von Uexküll is positioned close to behaviorism. However, he speculated about a "functional tone" acquired by objects in the mirror world. This notion is superficially similar to Gibson's (1966, 1979, almost half a century later) notion of "affordance". However, the difference is categorical. Gibson seeks the "throwability" of a stone in the stone, whereas von Uexküll finds it in the functional relation of the animal to the *Umgebung*. His example of the toad trying to eat match sticks provides a biological model of affordance. The "seek image" (*Suchbild*) deserves to be central in the understanding of perceptual awareness.

Affordances are what experiences *mean* in terms of living. There is no meaning in pure physics, meaning is self-imposed by sentient beings. Gibson failed to acknowledge this. It is the first stage of metaphor and symbolization (Ernst Cassirer 1944). Symbols common to all cultures have deep *biological* roots. This is even more evident from the fact that plants display structures of animal – and human – significance. For instance, many – themselves blind! – flowers offer striking visual Gestalts.

"Affordance" gained importance in philosophy due to Heidegger's (1926) musings on tools. Tools become "part of" the body. The blind man's cane is an example. Much of the world becomes invisible that way, a good thing too, for you could hardly survive otherwise. Examples of invisible tools are the ground you walk on and the air that surrounds you. You simply take these for granted, except in extreme situations. Tools extend the body, the body itself is just another tool of the mind, the one most familiar.

Despite such major ideas, von Uexküll, as a biologist, stays on the side of the sciences, rather than phenomenology. His "functional tone" (*Suchton*, *Leistungston*) *points* to the *Innenwelt* but cannot possibly intrude it, as he keenly understood. In order to talk about awareness proper one needs to cross the gap between behavior and phenomenology. Biology offers no such bridge.

Science cannot account for awareness in physical/physiological terms. All one can do is come up with a "psychophysical bridging proposition" that – by design – cannot possibly conflict with science, but has heuristic value. Science considers such attempts meaningless, both formally correct and intolerably restrictive. Odd enough, whereas "mechanisms" are strictly *out*, various have been proposed by "scientists". One of the best known is the "neural center of consciousness" (Francis Crick 1995). Almost all such proposals seem childish and useless to me, evidently self-contradictory, in conflict with known science, or without obvious heuristic value. A singular exception is Schrödinger's.

Schrödinger (1956) proposed that a spark of awareness results from the friction between intentional poking and the resulting resistance, like the reception of a reply to a question. The meaning of the answer is in the question. You can only learn what you are ready to ask, but you need an answer to *know*. You put a question to nature by poking, as the blind man does with his cane. The answers depend on the intention of the poking. Especially negative answers, that are expectations proven false, are informative. Schrödinger's proposition renders awareness *intentional inexistence* (Franz Clemens Brentano 1874) – a major advance from ethology proper. The "poking" may be understood as Arthur Schopenhauer's (1819) "Will to Live" (*Wille zum Leben*) or Friedrich Nietzsche's (1884/88) "Will to Power" (*Wille zur Macht*). Neither is personal, both are universal, at the roots of all sentience. Poking originates from mere random action, but may become arbitrarily focussed, thus enabling evolutionary development towards intentionality.

Schrödinger's proposition is in no danger to conflict with present or future scientific facts. Yet it has great heuristic value. It is a safe bet to turn a believer, you can't lose and have much to gain! Once accepted, awareness becomes a series of micro enlightenments due to intentional poking. I propose to call these "psychons". Don't confuse them with Sir John Eccles' (1994) notions. This epistemology puts experimental phenomenology on the

biological track.

Whitman Richards's Twenty Questions

Richards (1982) noticed that even short volleys of questions suffice for life's needs. The popular game of "Twenty Questions" proves that you have a good chance to guess *ANY* word – English passed the one million (20 bit!) word limit in 2009 – in less than twenty questions. The reason is that the human *Umwelt* is limited and structured, which allows you to ask informative questions. Most structures and phenomena repeat numerous times, so you know what to expect. Establishing a few unlikely coincidences adds up to virtual certainty. This is related to Gerhard Vollmer (1975) and Rupert Riedl's (1980) "hypothetical realism". It is the basis of the biological evolution of *ratio*. Richards's method of knowledge acquisition renders knowledge *knowledge*, that is to say *intentional*.

I have likened this process to *forensic investigation* (Koenderink 2011a). Consider an example. A dead body is found, possibly murdered. A flock of experts searches the scene of the crime for evidence, looking for foot prints, blood stains, DNA traces, possible murder weapons, witness accounts, concealed persons, cigarette butts, you name it! The limit is set by time, available personnel, financial and scientific resources. The result is an arbitrarily large file, most of which will certainly prove to be irrelevant, or will never be even consulted. All the detective needs to come up with a *plot* is a summary. Given the plot, some of the collected structure becomes relevant, most need never be consulted. It may be necessary to ask for additional data. Obtaining such additional data is expensive, so the plot is useful in deciding what might be relevant.

If the plot proves unfruitful, the detective drops it for another. He needs a plot that leads to the identification of a number of unlikely events. Probabilities of independent events *multiply,* a few suffice to get "beyond reasonable doubt". Once you're in the right direction you can select the "evidence" and ignore the rest. Wrapping up the case becomes routine. That is how Sherlock Holmes can be so uncanningly effective. I dub this mode of knowledge acquisition the "Sherlock Model".

This is the only way to ever solve – most of the time – such cases at all. The alternative would be to *compute* the solution from the forensic file. Although this sounds great, for all data is used, it is evidently *impossible*. This sheer nonsense is what vision research implies with "inverse optics" (Tommaso Poggio, Vincent Torre & Christof Koch 1985), essentially the method proposed by David Marr (1982). Richards's account of the Sherlock Model in a biological and phenomenological setting fills an important epistemological gap. It was initiated by the early attempts at Artificial Intelligence. It replaced passive reception with creative construction.

Jason Walter Brown on Psychogenesis

A yet higher level of awareness is understood by Brown on the basis of his studies of patients with specific mental disorders. Brown (1991) proposes a very general model that hits the

essence of our understanding of psychogenesis. I use "psychogenesis" in preference to "microgenesis" (Victor Rosenthal 2003), although I'm aware that both have various other uses. Brown's model is the exact *opposite* of the mainstream bottom up account of perception.

Brown notices that cortices are evolutionary recent additions and understands that they serve to *articulate*, rather than *generate*. He seeks the origin of awareness in the deep structures. Psychogenesis starts with vague emotive feelings, develops over dreamlike states to more articulate "final" states as a surge of activity moves towards the neocortex. The moment it arrives it dies, further articulation being impossible, the next wave already on its way. It is a legato style, systolic process. The "wave" is like a volley of "hallucinations" that are checked against the present contents of the sensorium, the superficial structure. What does not fit is mercilessly pruned, what fits progressively diversifies and competes in a ruthless evolutionary process. The final state represents the currently most likely "explanation" of the structure in the sensorium. Reality (*Wirklichkeit*) is an *achievement* of the mind, although science and analytic philosophy consider it its "input" – very strange, I would say even embarrassing.

This is "controlled hallucination", or "analysis by synthesis". It is a robust and stable engineering method that freewheels in the absence of input, readily deals with lacking data, or ambiguity and easily tunes to various "modes". Algorithms of this type are known as "soft computing" (Lofti Zadeh 1994). An instance fitting Brown's ideas perfectly is "harmony seeking" (Zong Woo Geem 2009).

Putting things together

In putting things together (figure 3) I could start at *any point in the loop*. I use an essentially arbitrary entry, think nothing of it.

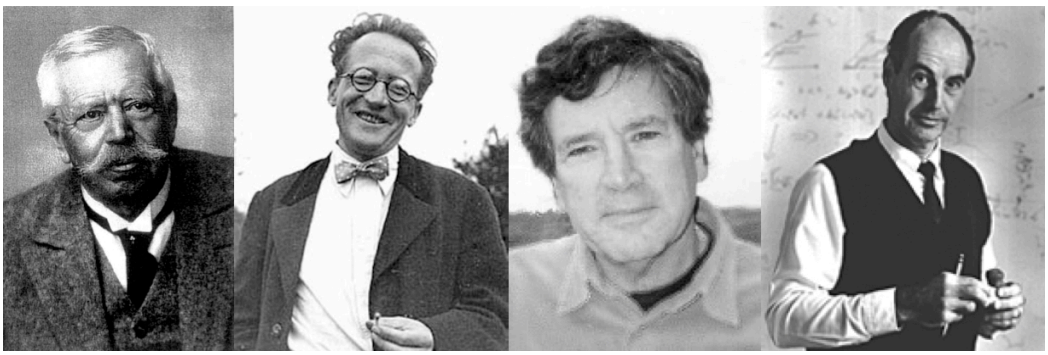

Fig. 3 From left to right Jakob von Uexküll, Erwin Schrödinger, Jason Walter Brown and Whitman Richards. All four are amongst my heroes – of course, I have plenty more. Such people move our understanding forwards, where would we be without them?

The sensorium can be simple, as a single receptor cell, or arbitrarily complicated, as the human "visual system". The sensory side of the human visual system includes the eye, and dozens of visual areas, the largest being primary visual cortex. This is the "optical

sensorium". What might be its function?

The mainstream notion is that the bulk of the "inverse optics computations" go on there. In my view this misses the boat altogether. Instead, I suggest that the system *doesn't compute anything*, but is essentially a volatile – continuously overwritten – data buffer of formatted and sorted optical structure. As useful and equally meaningless as a forensic file. That is to say, most of the structure is irrelevant and will be ignored. When needed in the current investigation, it is there, easy to find and convenient to consult. *Without ignoring almost all optical structure vision would be impossible*. Vision research has started to notice this (Arien Mack & Irvin Rock 1998; Jeremy Freeman & Eero Simoncelli 2011; others), but has yet to draw the ultimate consequences.

Richards's analysis of the "twenty questions" game yields a powerful handle on how the sensorium is structured so as to subserve the *Situationskreis* function effectively. It provides a principled method to describe its structure and function as it applies to the *Merkwelt*. It implements productive creativity.

How is the sensorium used and what uses it? It is the situational loop controller which continually generates hallucinations and checks them against the structure in the sensorium. This is Brown's model. It depends on current situational awareness and goals, the "plot". The plot may be changed at any time, (re-)setting the current viewing mode. The controller also sends messages to the motor system, so it codetermines – by way of eye, neck and leg muscles – the optical structure at the retinal level. The sensorium becomes something like a "blackboard architecture" (Daniel Corkill 1991).

Much never ends up in visual awareness because it subserves Gibson's "direct" perception, which is "optically guided behavior", rather than awareness proper. Awareness results from Schrödinger's psychons, which originate from the confrontation of hallucinations with the structure in the sensorium. Hallucinations are generated by the system, therefore have immediate significance. Anything not self-generated, but impinging on the system is alien and void of meaning. Nothing can possibly "enter" awareness. This is Giambattista Vico's (1725) proto-constructivist *VERUM FACTUM*. You notice this in small children, who will only understand your explanations when "ready for it". Once ready, they won't even need you, before that, they won't understand. Grandparents know that.

Awareness is a User Interface

Visual awareness is an aspect of the *Situationskreis*, neither in the head, nor in the environment. It involves current structures and processes that become noted in the *Spiegelwelt*, but somehow point at the *Gegengefüge*.

Organisms are constantly scheming for the future. The past is irrelevant to survival. They already succeeded doing so! The present simply *is*. There is nothing they can do to change it. It is their future that organisms need to deal with. There is still a chance to modify it! This works mostly undercover, automatically. Even awareness is almost never fully articulate. It has to contain various futures simultaneously, thus is necessarily ambiguous and fluid. In experimental phenomenology we strife for unique reports, thus *forcing the*

system. This intervention co-determines results. Multiple worlds in awareness (Koenderink 2001) are what yield the sense of freedom of choice, although decisions-in-action tend to be involuntary.

An apt description is "*visual awareness is an optical user interface"* (Donald Hoffman 2009; Koenderink 2011a). Visual objects are "icons" of the interface, this is the *mirror world*. Another apt term might be Gerard Manley Hopkins's "*inscape*". The *Spiegelwelt* is reality, "the mirror turned lamp" (Meyer Abrams 1953). Visual objects are part of your reality (*Wirklichkeit*). If you kick a rock – as Samual Johnson famously did after hearing a sermon by George Berkeley (1709), see James Boswell (1791) – you will hurt your toes. *The interface is hard-core REALITY!*

Hypothetical realism should not be confused with idealism. Yet *Wirklichkeit* is not *Realität,* the "physical world", conventionally called "reality". The physical world is a super-individual creation of *Homo Sapiens*. *Realität* contains objects like X-rays, galaxies and viruses that have no place in anyone's *Wirklichkeit*. It is a metabletic construct. The aether belonged to it in the 19th c., the superluminal neutrinos for a few months of 2012, the Higgs boson since last year. The heart used to be the site of the soul, but since William Harvey (1628) it is a pump and since Christiaan Barnard's operation (december 1967) it can be replaced, whereas the soul has turned into an epiphenomenon of the brain (Daniel Dennett 1996). If you believe in God's Eye even physics that will be discovered centuries from now is part of "reality". I'm not a believer and would strongly advice against it, but mainstream science – at least silently – is.

That you are aware of the *interface*, rather than the raw optical structure is evident from experiments with fragmented spatiotemporal optical structure (Koenderink et al. 2012a, b). A movie in which both time and space are locally scrambled is experienced as smooth and normal. Inverse optics would ideally yield a "veridical" result, which would then have to *look* scrambled! But it does not, the interface *has no template for scrambled scenes*. It only presents you with likely narratives – though not necessarily *physically* possible ones. Psychogenesis assumes that *anything goes* in principle, but only generates what does fit its current generic structures. If purple stones start falling upwards tomorrow you'll soon get used to that. "Veridicality" cannot be a goal, because the organism lacks God's Eye.

Psychogenesis of visual awareness is a proto-rational system, Egon Brunswik's (1955) "ratiomorphic apparatus". Mere optical structures (*Merkbilder*) are turned into meaningful images (*Bedeutungsbilder*) through a Procrustean process that forces them into template-like structures (*Suchbilder* at various levels). Thus physical structures (*Merkmalsträger*) are reified as intentional "objects" of reality (*Wirklichkeit*). These are the tools and affordances of the reality of hypothetical realism. Most remain subsurface, some make it into reflective thought. In the visual arts this is Sir Ernst Gombrich's (1960) "The Beholder's Share".

Rational thought often finds occasion to "correct" immediate awareness, whereas the latter is the essential foundation for it. What to side with in this instance of the Liar Paradox (attributed to Eubulides of Miletus, 4thc. BCE)? Your choice will reveal you as artist or scientist. In any case, proto-rationality should be regarded with awe. It has been honed to fit physical structure since our "Last Universal Common Ancestor", that is four billion years

ago! It is far less prone to silly, potentially lethal mistakes than our human ratio (Riedl 1980; Vollmer 1975). Newspapers prove this daily beyond all reasonable doubt.

The Role of Templates

Visual objects start out as hallucinations, von Uexküll's *Suchbilder*. They become arbitrarily articulate and specific, but necessarily possess a template character. *You see what you are able to see*. That is why expert bird watchers see so much more than you.

Template structures are the *releasers* (Lorenz 1973; Tinbergen 1951) of animal ethology. A small warbler may take a cuckoo chick twice its own size for its young, swans have been seen to feed fish, apparently taking them for their chicks, and so forth. The literature abounds with striking examples (Riedl 1980). How silly can vertebrates be? Is *Homo Sapiens* the singular exception?

Are humans indeed unique in possessing God's Eye (Koenderink 2014a)? Far from it, this anthropocentric notion is easily proven wrong empirically (figures 4 through 7). Template structures abound when you care to look for them. Well known examples of such templates are the Gestalts. So are the numerous "illusions" that you *know* to be "unreal" on various grounds (Brown 2004), yet stubbornly *look the way they do*. Reality (*Wirklichkeit*) is an achievement. It doesn't come for for free, nor by way of some trivial computation.

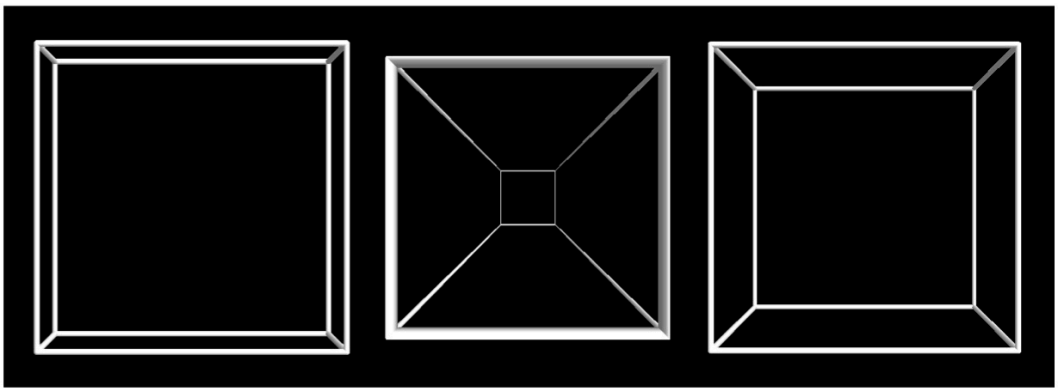

Fig. 4 Example of a template. These are one-point-perspective renderings of a cube, designed for rather different viewing distances. As seen from their "correct" viewpoints they "should" look the same. But this is not the case (Sylvia Pont et al. 2012). From *any viewpoint* human observers rate the three pictures (from left to right) as "shallow slab", "deep corridor" and "cubical". Psychogenesis does not use perspective reasoning at all, but simply applies a template.

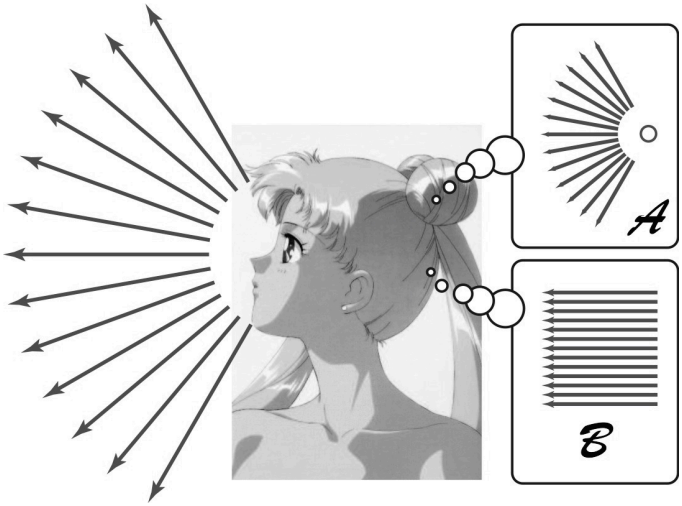

Fig. 5 The visual rays fan out from the eye and fill a hemispherical cone. Thus the model used by psychogenesis should be like A, yet for the majority of observers it is more like B: all visual rays parallel (Hermann von Helmholtz 1892; Koenderink et al. 2009)! This gives rise to a number of striking "illusions" (Koenderink et al. 2010). This is another instance of a surprising template structure that dominates visual awareness.

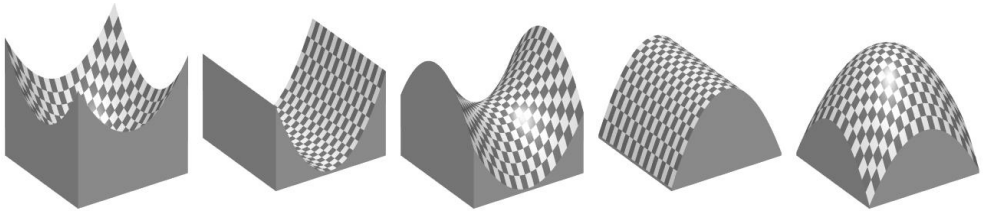

Fig. 6 The qualitatively distinct local surface shapes as categorized by Carl Friedrich Gauss (1827) in the early 19thc. However, for centuries the official taxonomy was that due to Leon Battista Alberti (1435) who omitted the saddle category (middle). The amazing fact is that nobody noticed! Psychogenesis has templates for cups, caps, ridges and ruts, but not for saddles (Koenderink et al. 2014b). This can be seen in the sculptures of most historical cultures (Leonard Rogers 1969).

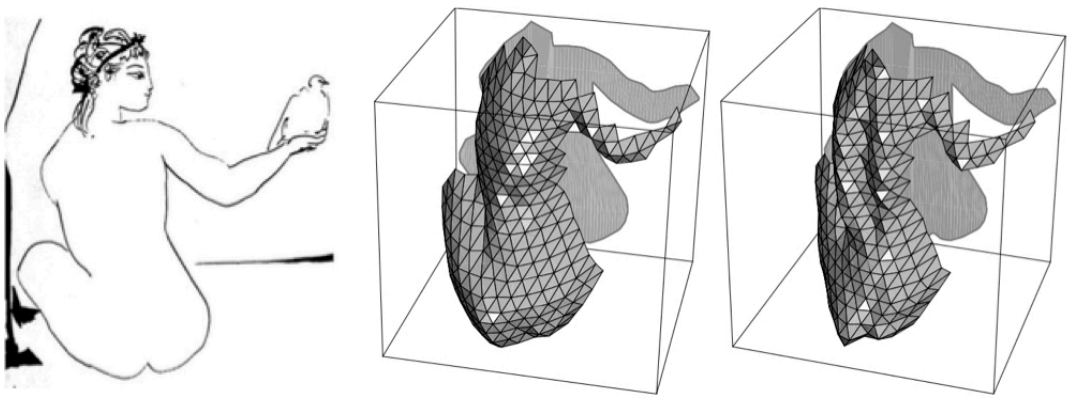

Fig. 7 Two pictorial reliefs (center and right) obtained for an outline drawing by Picasso (left). The observers apparently "hallucinated" the relief of the blank interior (Koenderink et al. 2012). Notice the differences between these observers. At left the outline is interpolated with some balloon-like surface. At right the observer has applied a template appropriate to human dorsal anatomy. Notice the furrow of the spinal column, which Picasso never drew but no doubt saw.

Ontology of the Mirror World

I use *Gestalt* synonymous with "object of visual awareness". I could as well have focussed on the auditory or haptic modalities. Gestalts come in great variety. Their common nature is that they withdraw from analysis, that "nothing can be changed". Phenomenologically they are created and annihilated instantaneously. Some are short living "glimpses", others seem "immutable".

It happens frequently that you see something which is immediately replaced with something else. You have to be mindful to notice, many people ignore mere glimpses. Such Gestalts last only for a moment. Brown's psychogenesis runs at a systolic cycle of about a dozen a second. These are the most fleeting Gestalts – important as they are.

Most people "see everything in front of them" (figure 5), more precisely, experience the half-space in front of them as contained in a visual field of about a right angle or less in diameter (Koenderink et al. 2009). This "cone of vision" is an immutable Gestalt, recreated in each Brownian cycle. Again, you have to be mindful to notice (Helmholtz 1892; Johannes Kepler 1604).

Gestalts are not necessarily of a *static* nature, Typically they are *happenings*. A handshake is a Gestalt that lasts for seconds, but has no parts (Ekaku Hakuin 18thc. CE). There are numerous examples of this. Most have an obvious template character. Happenings account for the bulk of your experience.

A Gestalt may be a simultaneous presence without explicit spatial structure, think of the grace of a pose, or the trod of a horse. Space and time do not really enter as frameworks. Gestalts surely have "spatiotemporal texture" but they can't be analyzed in term of that. The grace of a human pose is not likely to impress a bird, again suggesting a template character.

Objects of visual awareness are complete and meaningful as they are. The "meaning" is not of reflective thought, but *visual* meaning that cannot be put into words. Objects are not assembled from entities – sense data? qualities? – that are themselves not visual objects. They spring to life "fully armed" as Athena from the skull of Zeuss. They have a physiognomic character that cannot be analyzed. Gestalts are proto-metaphors, or proto-symbols of strands of experiences, with deep biological roots, like the releasers of birds and fishes, our vertebrate kin. They sum up many mutually related experiences, thus give rise to a barrage of interpretations.

Gestalts come in perplexing variety. The quest for a full taxonomy is utterly utopic. The mirror world is inexhaustible because we never experience its limits. *"The eye cannot see itself"* (William Shakespeare, *Julius Caesar*, Act 1, Scene 2). Inexhaustible does not imply *finite*. God's Eye sees much more! Consider a frog starving in front of a pile of dead flies. Its "objects" are *living* flies. It cannot see *dead* flies, even when just as nourishing and much easier to "catch" (Jörg-Peter Ewert 2004). The frog cannot see its limits. Nor can humans.

In a Gestalt "nothing can be changed", yet Gestalts are largely *unpredictable*. This is a lethal combination that rules out mereological or logical descriptions (Henri Bergson 1907). Gestalts share this with works of art (Koenderink 2
011b). The mirror world is an *aesthetic dimension*. Visual objects "stare at us from the outside", confronting us. Inside and outside become confused because the *Funktionskeis* has no beginning nor end. *Wirklichkeit* is a hall of mirrors.

Psychogenesis generates Gestalts in countless numbers, although not many populate our immediate visual awareness at any time. They don't mutually interact. They don't have parts and they don't depend on being part of anything. They are pure individuals.

> "*No two created beings are exactly alike. And their individuality is no imperfection. On the contrary, the perfection of each created thing is not merely its conformity to an abstract type but in its own individual identity with itself.*" (Thomas Merton 1949)

The mirror world has a *flat ontology*. Difference or similarity are neither visual objects, nor qualities, in that sense objects of the mirror world are fully autonomous. Recreated any moment, visual objects cannot change, or "do" anything. An *illusion* of mereological structure is perhaps suggested by such objects as a "swarm of birds". But the swarm is not "made up of birds", it just has "birdie" qualities. It is a unique visual object. Instead of assembling parts, psychogenesis freely creates novel Gestalts like swarms (David Elkind 1964) or happenings (Albert Michotte 1954).

Nor is there any interaction between Gestalts. Any so called "interaction" is itself an object (Michotte 1954), a happening. In a flat ontology *objects just are*. Occasionalism or perhaps synchronicity (Carl Gustav Jung 1952) is more apt as a description than causation. Awareness – which includes all its objects – is (re-)created from scratch at each moment.

Gestalts are mutually independent, but reflect each other. Visual awareness is more like a densely textured felt than a mere bag of marbles. You can't really pry it part. It resembles Gottfried Wilhelm Leibniz's (1714) monads, which have no windows, yet all reflect each other. This reminds one of von Uexküll's musical poetry of life. Both Leibniz and von Uexküll were crucified by analytical philosophy, the one because his monads had to be launched by a God and the other because of his vitalism. Very similar capital crimes if you come to think of it! We are in no position to laugh at them but should strife to make the best sense we can of their important intuitions. The alternative leads to a dead end, the arid desert of analytical philosophy.

"Qualities" are properties of Gestalts, but Gestalts are not bundles of qualities, nor is a quality a Gestalt. "Red" of a rose is unlike "red" of blood or a carpet. "Red" is an abstract symbol, not a visual object, much as "cat" is. "Cat" is not a Gestalt, you can't see it, although one frequently notices Gestalts with a feline quality. In a sense, Gestalts don't *have* qualities and meanings, but *are* them – though not as proper parts.

Numerous abstract symbols exist, think of "world", "nature", "space", "time", "shape" and "self". You cannot possibly "see" these. They are bona fide mental objects, not Gestalts, but objects of reflective thought. Examples include the "round square" and the "golden mountain" (Meinong 1899). "Nature" and "round square" are in similar categories. Reflective thought is distinct from immediate awareness. Thinking *you do*, whereas awareness *happens to you*.

The mirror world is an aesthetic dimension, it is *creative*. As Leonardo da Vinci (*ca.* 1540) relates, when you keep looking at some old dirty wall – take your time! – you will experience wonderful scenes. Their scope is only limited by the scope of your mind:

…

> *For, as on the coloured canvass*
> *Subtle pencils softly blend*
> *Dark and bright, in such proportions*
> *That the dim perspectives end—*
> *Now, perhaps, like famous cities,*
> *Now, like caves or misty capes,*
> *For remoteness ever formeth*
> *Monstrous and unreal shapes.*
> …
> (Pedro Calderón de la Barca 1629, *El príncipe constante*, Act I, Scene I. The gardens of the King of Fez, by the sea – part).

In cases where the optical structure readily admits of competing Gestalts – think of the Necker cube (Louis Albert Necker 1832), or the duck-rabbit (Anonymous 1892) – you notice an alternation that is not quite under voluntary control (Wolfgang Metzger 1936), suggesting that psychogenesis created *both*. Immediate visual awareness is the tip of the iceberg, the Brownian systolic cycle yielding much that remains hidden. Any Gestalt can give way to something else at the drop of a hat. Literally! A snap of the fingers or a heartbeat might do the same. Any Gestalt is *mysterious* in the sense that one may never exhaust *what else* it might be (John Ruskin 1843-60). This is the notion of "equivalence", explored by Alfred Stieglitz (1925–1934) and Minor White (1963) in photography. "Seeing as" is a corner stone of creative vision. It eludes logic as opposites meet and alternatives are not excluded.

All this fit very well with the familiar fact that we see through the eyes of the great painters. Van de Berg (1965) was right that the human mind has significantly changed in historical time. We are blind to such changes, only coming to know them in retrospect, through historical research. How did landscapes look before Claude Monet, nude women before Amadeo Modigliani, or animals before Franz Marc? Of course, we'll never know.

Conclusions

Immediate visual awareness is an *optical user interface*. Von Uexküll has brought its structure and biological origins to our attention. He also speculated on the *Innenwelt*, the phenomenology of the organism's *Wirklichkeit*. He developed the concept of "affordance" or "functional tone" in a non-Gibsonean way that allowed him to understand the being of the cane for the blind. The notion of functional tone still remains on the side of behaviorism rather than that of phenomenology. Schrödinger's proposition bridges this gap. It is a powerful heuristic without scientific consequences. That is exactly its strength. Competing notions like the "center of consciousness" or Eccles' quantum-interactionism (1994) make meaningless claims. Von Uexküll's notions augmented with Schrödinger's proposal fit seamlessly in Brown's account of psychogenesis as controlled hallucination. Mechanisms like Richards' "twenty questions" or Koenderink's Sherlock Holmes' method of investigation suggest how psychogenesis might be implemented in algorithmic terms.

I borrowed von Uexküll's term "Mirror World" for my account. It is based on templates

(*Suchbilder*), which means that its objects are limited to what one has learned to see. Research on child development (Elkind 1964) and the feats of experts like bird watchers corroborate this. The repertoire is probably not fixed. It starts with the vertebrate "core systems" (Elisabeth Spelke & Sang Ah Lee 2012; Giorgio Vallortigara et al. 1990) but can be further developed, even later in life. In that sense *Homo Sapiens* seems at least quantitatively remarkable. Development implies experience and mindfulness, yet happens at the gut level.

The phenomenology of visual awareness is an *ontology of the mirror world*. It is a flat ontology of Gestalts. This has far reaching implications for phenomenological vision research since its Gestalts are not bundles of qualities and notions as space, shape, world, causality, have to be reinterpreted. It implies a major deviation from current mainstream convictions. Brown (1999) discovered parallels in the philosophy of early (Abhidharmika) Buddhism (Theodore Stcherbatsky 1923).

The mirror world is a creative, aesthetic dimension. Therefore the visual arts – not the "conceptual arts" – are experimental phenomenology "carried on by other means" (Carl von Clausewitz 1832). They are attempts to render the mirror world symbolic and share it with others, just as language is such an instrument subserving reflective thought (Konrad Fiedler 1887; Susan Langer 1953).

The first task set to *cognitive vision*, or "apperception", is like the parsing of a work of the visual arts (Koenderink in press), namely an attempt at a taxonomy of the contents of visual awareness. It is like the task set to Adam and Eve in the Garden of Eden. The human mind appears made for that. "Eye measure" taxonomies of the animal and vegetable Kingdoms hardly required correction from DNA-based cladistics. Perhaps surprisingly, science did not recognize this for the miracle it surely is, nor ever grasped how it was done. Understanding has hardly progressed beyond Johann Wolfgang von Goethe's (1790).

The proper study of awareness is the experimental ontology of the mirror world. Given the hall of mirrors structure of the mind it is an experimental ontology of *Wirklichkeit*.

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Summary I consider the ontology of the "objects" of immediate visual awareness. The ethological account is due to Jakob von Uexküll, from whom I borrow the term "*mirror world*". His account is essentially behavioristic, thus fails to cross the bridge to phenomenology. Yet, von Uexküll came perhaps as close as possible. Erwin Schrödinger's *psychophysical bridging proposition* establishes this connection. Jason Walter Brown's account of psychogenesis, based on a lifelong study of mental disorders, fits in seamlessly. From an algorithmic perspective it is "analysis by synthesis". This inherently *intentional* "guessing" strategy for the acquisition of knowledge was proposed by Whitman Richards. Visual awareness is a "user interface", its objects properly called "Gestalts". It is intentional, yet grounded in biology. I attempt to broadly sketch an ontology of this "mirror world".
Keywords: visual awareness, mirror world, user interface, Gestalt.

Zusammenfassung Ich untersuche die Ontologie der "Objekte" der unmittelbaren visuellen

Vorstellung. Das Begriff “Spiegelwelt” entlehne ich Jakob von Uexküll. Seine Deutung ist im wesentlichen Verhaltensforschung, damit steht er ausserhalb das Domain der Phänomenologie. Zwar kam von Uexküll so nahe heran wie überhaupt möglich. Erwin Schrödinger schlagt eine psychophysische Überbrückungsthese vor welche einen Zusammenhang zwischen Verhalten und Phänomenologie herstellt. Jason Walter Brown beschrieb die Struktur der Psychogenese auf den Basis eines lebenslangen Studium psychischen Störungen wie Seelenblindheit und Hallucination. Seine Beschreibung fügt sich hier nahtlos ein. Von einer algorithmischen Perspektive kann man es als sogenannten "Analyse durch Synthese" auffassen. Diese Strategie des “gezieltes Raten" für die Schöpfung von Erkenntniss wurde von Whitman Richards entwickelt. Die Vorstellung ist eine "Benutzerschnittstelle", ihre Objekte sind die "Gestalten” der empirischen Phänomenologie. Es existiert zwar ausserhalb, ist doch indirekt gewurzelt in der Biologie. Ich versuche die Ontologie dieser “Spiegelwelt” in ihren rohen Umrisse zu skizzieren.
Schlüsselwörter: Vorstellung, Spiegelwelt, Benutzerschnittstelle, Gestalt.

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Jan Koenderink (born Stramproy 1943) is a professor emeritus of physics from Utrecht University. He publishes in physics, mathematics, psychology, philosophy and computer science. In recent years he has focussed on experimental phenomenology, philosophy of mind and the ontology of the visual arts. He was awarded an honorific doctoral degree in medicine by the University of Leuven (1987) and the "Azriel Rosenfeld Lifelong achievement award" (in computer vision) by the IEEE in 2014. In 2010 the ECCV founded the biannual "Koenderink Prize" for Fundamental Contributions in Computer Vision. He published books on shape (Solid Shape, 1990) and color (Color for the Sciences, 2010). A number of his ebooks can be freely downloaded from "de Clootcrans Press" (http://www.gestaltrevision.be/en/resources/clootcrans-press).
Address: Prof.em. dr. dr.h.c. Jan J. Koenderink, Universiteit Leuven (KU Leuven), Laboratorium voor Experimentele Psychologie, Tiensestraat 102, bus 3711, B3000 Leuven, België.
E-Mail: KoenderinkJan@gmail.com